



GWANDA STATE UNIVERSITY
FACULTY OF ENGINEERING AND ENVIRONMENT
DEPARTMENT OF METALLURGICAL ENGINEERING
PYROMETALLURGY - FERROUS
EMG 3105
Part III First Semester Second Segment Examination Paper
December 2024

This examination paper consists of 3 printed pages

Time Allowed: **3 hours**

Total Marks: **100**

Ms K Mahamba

INSTRUCTIONS

1. Answer **ALL** questions in **Section A** and any **TWO** from **Section B**

2. Use of calculators is permissible

Additional Requirements

MARK ALLOCATION

Section A	50 Marks
Section B	50 Marks
Part Questions	As shown in each part question
Total Attainable	100

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION (50 MARKS)

QUESTION 1

- a. Discuss any two methods used in the blending iron ores. [10]
What is the effect of fluctuations in charge ore materials quality on the blast furnace performance? [5]
- b. State any 5 causes of failure of furnace lining and how this can be avoided. [5]
- c. What are the main impurities in steel making process (brought by both hot metal and steel scrap) and how are they removed from the steel melt. [5]
- d. What are the main differences BOF and EAF steelmaking processes, stating why steel scrap is used as part of the raw materials in BOF steelmaking. [10]
- e. You are given two oxides of manganese; MnO and Mn₂O₇, state giving reasons which would be the network breaker and network former. [5]
- f. Describe the raw materials used in the blast furnace iron making process and how they are prepared before feeding to the blast furnace. What are the roles of metallurgical coke in iron making blast furnace process. [10]

SECTION B (50 MARKS): ANSWER ANY 2 QUESTIONS

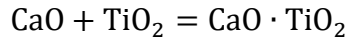
QUESTION 2

- a) Zimbabwe is in the process of reviving its steel production plants, describe in details the ironmaking process indicating the raw materials and their preparation. Discuss the main chemical reactions occurring in different zones of the blast furnace in ironmaking; include slag evolution in your discussion? [25]

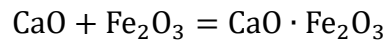
QUESTION 3

- a) The high grade iron ores have depleted leaving abundance of low grade ores such as titanium containing iron ores. Iron ores are prepared for the blast furnace process

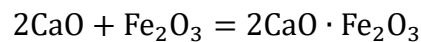
through the sintering process were calcium ferrites are the most desired bonding phases because of their better strength and reducibility in sinter. Using the thermodynamic data provided below plot ΔG° vs Temperature diagram at a temperature range of 1000-1400°C and discuss the evolution of the bonding phases in the sinter and its implications. [25]



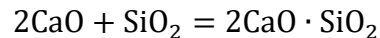
$$\Delta G^\circ = -79\,900 - 3.35T \text{ (J/mol)}$$



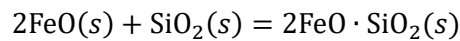
$$\Delta G^\circ = -7\,100 - 1.15T \text{ (J/mol)}$$



$$\Delta G^\circ = -53\,100 - 2.51T \text{ (J/mol)}$$



$$\Delta G^\circ = -120\,000 - 11.3T \text{ (J/mol)}$$



$$\Delta G^\circ = -36,200 + 21.09T \text{ (J/mol)}$$

QUESTION 4

a. Describe in detail with the aid of a flow diagram the mixing and the furnace methods used in the production of low carbon ferrochrome. [20]

b. Metallothermic reduction is applied in the production of low carbon ferrochrome. What are the possible metals that can be used in this process and what is the main governing principle that determines the feasibility of these types of reactions? [5]

THE END!!!!